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**CoRE Link-Format to DNS-Based Service Discovery Mapping**  
**draft-lynn-core-discovery-mapping-01**

Abstract

Resource and service discovery are complimentary. Resource discovery provides fine-grained detail about the content of a server, while service discovery can provide a scalable method to locate servers in large networks. This document defines a method for mapping between CoRE Link Format attributes and DNS-Based Service Discovery fields so the two methods may be used interchangeably to locate services.

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## **1. Introduction**

The Constrained RESTful Environments (CoRE) working group aims at realizing the REST architecture in a suitable form for the most constrained devices (e.g. 8-bit microcontrollers with limited RAM and ROM) and networks (e.g. 6LoWPAN). CoRE is aimed at machine-to-machine (M2M) applications such as smart energy and building automation. The main deliverable of CoRE is the Constrained Application Protocol (CoAP) specification [[I-D.ietf-core-coap](#)].

Automated discovery of resources hosted by a constrained server is critical in machine-to-machine applications where human intervention is minimal and static interfaces result in fragility. CoRE Resource Discovery is intended to support fine-grained discovery of hosted resources, their attributes, and possibly other resource relations [[I-D.ietf-core-link-format](#)].

In contrast, service discovery generally refers to a coarse-grained resolution of an end-point's IP address, port number, and protocol. This definition may be extended to include multi-function devices, where the result of the discovery process may include a path to a resource representing a RESTful service interface as well as a reference to a description of the interface such as a Web Application Description Language (WADL) document [[I-D.vial-core-link-format-wadl](#)].

Resource and service discovery are complimentary in the case of large networks, where the latter can facilitate scaling. This document defines a mapping between CoRE Link Format attributes and DNS-Based Service Discovery [[I-D.cheshire-dnsext-dns-sd](#)] fields that permits discovery of CoAP services by either means. It also satisfies the following CoRE charter requirement [[I-D.shelby-core-coap-req](#)]:

REQ8: A definition of how to use CoAP to advertise about or query for a Device's description. This description may include the device name and a list of its Resources, each with a URL, an interface description URI (pointing e.g. to a Web Application Description Language (WADL) document) and an optional name or identifier. The name taxonomy used for this description will be consistent with other IETF work, e.g. [draft-cheshire-dnsext-dns-sd](#). [charter]

### **1.1. Terminology**

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in "Key words for use in RFCs to Indicate Requirement Levels" [[RFC2119](#)].



## **1.2. Resource Discovery**

The main function of Resource Discovery is to provide Universal Resource Identifiers (URIs, called links) for the resources hosted by the server, complemented by attributes about those resources and perhaps additional link relations. In CoRE this collection of links is carried as a resource of its own (as opposed to HTTP headers delivered with a specific resource).

[I-D.ietf-core-link-format] specifies a link format for use in CoRE Resource Discovery by extending the HTTP Link Header Format [[RFC5988](#)] to describe these link descriptions. The CoRE Link Format is carried as a payload and is assigned an Internet media type. A well-known URI `"/.well-known/core"` is defined as a default entry-point for requesting the list of links about resources hosted by a server, and thus performing CoRE Resource Discovery.

Resource Discovery can be performed either via unicast or multicast. When a server's IP address is already known, either a priori or resolved via the Domain Name System (DNS) [[RFC1034](#)][RFC1035], unicast discovery is performed in order to locate the entry point to the resource of interest. This is performed using a GET to `/.well-known/core` on the server, which returns a payload in the CoRE Link Format. A client would then match the appropriate Resource Type, Interface Description, and possible Content-Type [[RFC2045](#)] for its application. These attributes may also be included in the query string in order to filter the number of links returned in a response.

## **1.3. Resource Directories**

In many M2M scenarios, direct discovery of resources is not practical due to sleeping nodes, limited bandwidth, or networks where multicast traffic is inefficient. These problems can be solved by employing an entity called a Resource Directory (RD), which hosts descriptions of resources held on other servers, called end-points (EP), and allows lookups to be performed for those resources. An end-point is a web server associated with specific IP address and port; thus a physical device may host one or more end-points. End-points may also act as clients.

The Resource Directory implements a set of REST interfaces for end-points to register and maintain sets of Web Links, called resource directory entries. [[I-D.shelby-core-resource-directory](#)] specifies the web interfaces that an RD supports in order for web servers to discover the RD and to register, maintain, lookup and remove resource descriptions; for the RD to validate entries; and for clients to lookup resources from the RD. Furthermore, new link attributes useful in conjunction with an RD are defined.



#### 1.4. DNS-Based Service Discovery

DNS-Based Service Discovery (DNS-SD) defines a conventional method of configuring DNS PTR, SRV, and TXT records to facilitate discovery of services (such as CoAP servers in a subdomain) using the existing DNS infrastructure. This section gives a cursory overview of DNS-SD; see [\[I-D.cheshire-dnsext-dns-sd\]](#) for a detailed specification.

DNS-SD Service Names are limited to 255 octets and are of the form:

Service Name = {Instance}.{Service}.{Domain}

The {Domain} part of the service name is identical to the global (DNS subdomain) part of the authority in URIs that identify the resources on an individual server or group of servers. {Domain} may identify a building zone as shown in the examples of [\[I-D.vanderstok-core-bc\]](#).

The {Service} part is composed of at least two labels. The first label of the pair is an underscore character generally followed by the application protocol name [\[I-D.ietf-tsvwg-iana-ports\]](#). The second label is always "\_udp" for CoAP services. In cases where narrowing the scope of the search may be useful, these labels may be optionally preceded by a subtype label (beginning with an underscore) followed by the "\_sub" label. An example of the {Service} part is "\_lamp.\_sub.\_dali.\_udp". Only the rightmost pair of labels is used to name SRV and TXT records.

The default {Instance} part of the service name may be set at the factory or during the commissioning process. It SHOULD uniquely identify a {Service} within a {Domain}. Taken together, these elements comprise a unique name for an SRV record (and optionally a corresponding TXT record) within the DNS subdomain.

The granularity of a service name MAY be that of a host or group, or it could represent a particular resource within a CoAP server. The SRV record contains the host name (AAAA record name) and port of the service (and protocol is part of the service name). In the case where a service name identifies a particular resource, the path part of the URI must be present in a corresponding TXT record.

A DNS TXT record is in practice limited to a few hundred octets in length, which is indicated in the resource record header in the DNS response message [\[I-D.cheshire-dnsext-dns-sd\]](#). The data consists of one or more strings comprising a key=value pair. By convention, the first pair is txtver=<number> (to support different versions of a service description). An example string is:

| 0x08 | t | x | t | v | e | r | = | 1 |





## **2. Mapping CoRE Link Attributes to DNS-SD Records**

[I-D.shelby-core-resource-directory] defines two new CoRE Link Format attributes that are particularly useful in conjunction with RDs:

```
link-extension    = ( "ins" "=" quoted-string ) ; Max 63 octets
link-extension    = ( "exp" )
```

The Resource Instance "ins" attribute is an identifier for a resource that makes it possible to distinguish from other similar resources. This attribute SHOULD be unique across resources with the same Resource Type attribute in the domain in which it is used.

If the "exp" attribute is defined for a link, then the following CoRE specific target attributes (defined in [I-D.ietf-core-link-format]) are intended to be exported directly into DNS-SD. The values are subject to format and length constraints as specified in [I-D.cheshire-dnsext-dns-sd].

### **2.1. Resource Instance "ins" attribute mapped onto {Instance}**

The Resource Instance "ins" attribute maps to the {Instance} part of a DNS-SD service name. It is stored directly in the DNS as a single DNS label of canonical precomposed UTF-8 [RFC3629] "Net-Unicode" (Unicode Normalization Form C) [RFC5198] text. However, to the extent that the "ins" attribute may be chosen to match the DNS host name of a service, it SHOULD use the syntax defined in [Section 3.5 of \[RFC1034\]](#) and [Section 2.1 of \[RFC1123\]](#).

The {Instance} part of the name of a service being offered on the network SHOULD be configurable by the user setting up the service, so that he or she may give it an informative name. However, the device or service SHOULD NOT require the user to configure a name before it can be used. A sensible choice of default name can allow the device or service to be accessed in many cases without any manual configuration at all. The default name should be short and descriptive, and MAY include the device's MAC address, serial number, or any similar hexadecimal string in an attempt to make the name globally unique.

DNS labels are currently limited to 63 octets in length and the entire service name may not exceed 255 octets.

### **2.2. Resource Type "rt" attribute mapped onto {Service}**

The resource type "rt" attribute is mapped onto the {Service} part of a DNS-SD instance name (as defined in [Section 1.4](#)) and must conform to the following format. It must be comprised of Net-Unicode text



strings, each preceded by an underscore '\_' and limited to 16 octets in length. The strings must be separated by periods '.' and end with the defined CoAP transport label "\_udp". The resulting string is used to form labels for DNS-SD records which are stored directly in the DNS.

### **2.3. {Domain} mapping**

[TBD: A method must be specified to determine in which DNS zone the CoAP service should be registered. See, for example, Section 11 in [\[I-D.cheshire-dnsext-dns-sd\]](#).]

### **2.4. TXT Record strings**

The resource <URI> is exported to the TXT record string "PATH={URI}".

The Interface Description "if" attribute is exported to the TXT record string "IF={Interface Description}".

The DNS TXT record can be further populated by importing any other resource description attributes as they share the same key=value format specified in Section 6 of [\[I-D.cheshire-dnsext-dns-sd\]](#).

## **3. Examples**

Assuming the ability to query a Resource Directory , or multicast a GET (?exp) over the local link, CoAP resource discovery can be used to populate the DNS-SD database in an automated fashion. CoAP resource descriptions (links) can be exported to DNS-SD for exposure to service discovery by using the Resource Instance attribute as the basis for a unique service name, composed with the Resource Type as the {Service}, and registered in the correct {Domain} [selection method TBD]. The agent responsible for exporting records to the DNS zone file SHOULD be authenticated with the DNS server.

[TBD: Examples]

## **4. IANA Considerations**

This document makes no request of IANA.

Note to RFC Editor: this section may be removed on publication as an RFC.



## **5. Security Considerations**

[TBD]

## **6. Acknowledgments**

Contributions and review comments were made by Anders Brandt, Angelo Castellani, and Peter van der Stok.

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